

CLAIMS

WHAT IS CLAIMED IS:

1. A method comprising:

storing state data update messages and corresponding acknowledgement messages in a standby control unit of a network device, wherein each of the state data update messages and the respective one of the acknowledgement messages includes a corresponding state change identifier; and

upon an occurrence of a failover event, selectively replaying state information to an interface component of the network device from the standby control unit based upon the state change identifiers of the stored state data update messages and acknowledgement messages.

2. The method according to claim 1, wherein selectively replaying state information comprises:

identifying a standby process within the standby control unit containing current state information that is not synchronized state information of a corresponding client process within the interface component; and

transmitting current state information maintained by the standby process to a corresponding client process within the interface component to re-synchronize the state information of the client process and the state information of the standby process.

3. The method according to claim 2, wherein the state data update messages, the acknowledgement messages, and the current state information transmitted by the standby process are transmitted using a unique virtual communication channel between the standby process and the corresponding client process.

4. The method according to claim 2, wherein identifying a standby process comprises:

identifying a set of second state data update messages stored by the standby control unit that are not associated with corresponding acknowledgement messages;

requesting retransmission of the acknowledgement messages by the interface component to identify acknowledgement messages lost as a result of the failover event; and

identifying the standby process based on one or more of the set of second state data update messages that remain unassociated with corresponding acknowledgement messages after the requested retransmission.

5. The method according to claim 2, wherein each of the state data update messages and each of the acknowledgement messages comprise a cookie data field permitting the standby process to encode additional data used to reduce the current state information required to re-synchronize the state information of the client process.

6. The method according to claim 2, wherein the standby control unit maintains the current state information associated with the standby process following selected replay of state information.

7. The method according to claim 2, wherein the standby control unit comprises only one standby process.

8. The method according to claim 2, wherein the standby control unit comprises at least two standby processes.

9. A method comprising:

communicating a first state data update message from a primary control unit to an interface component and a second state data update message to a standby control unit to update state information within the interface component and the standby control unit, the first and second state data update messages having a common unique operation identifier (ID);

communicating an acknowledgement message from the interface component to the standby control unit to indicate the successful processing of the first state data update message, the acknowledgement message having the unique operation ID;

upon receipt of both the second state data update message and the acknowledgement message, processing the second state data update message in the standby control unit; and

upon an occurrence of a failover event, selectively replaying state information from the standby control unit to the interface component when the second state data update message was received without a corresponding acknowledgement message.

10. The method according to claim 9, wherein communicating an acknowledgement message comprises:

communicating the acknowledgement message from the interface component to the primary control unit; and

forwarding the acknowledgement message from the primary control unit to the standby control unit.

11. The method according to claim 9, wherein communicating an acknowledgement message comprises communicating the acknowledgement message from the interface component directly to the standby control unit.

12. The method according to claim 9, wherein the second state data update message contains state information for use in updating state information maintained within the standby control unit.

13. The method according to claim 12, wherein the first state data update message contains at least a subset of the state information contained within the second state data update message.

14. The method according to claim 9, wherein the standby control unit stores the second state data update message and the acknowledgement message in a pending message queue.

15. The method according to claim 14, wherein selectively replaying state information comprises:

identifying a standby process within the standby control unit containing current state information that is not synchronized with a corresponding client process in the interface component using the second state data message and the acknowledgement message stored within the pending message queue; and

transmitting current state information maintained by the standby process to a corresponding client process within the interface component to re-synchronize the current state information in the standby process and the state information in the corresponding client process.

16. The method according to claim 15, wherein each of the first state data update message, each of the second state data update message, each of the acknowledgement message, and current state information transmitted to re-synchronize state information of the client process are transmitted using a unique virtual communication channel between the standby process and the corresponding client process.

17. The method according to claim 16, wherein the identifying a standby process within the standby control unit comprises:

identifying any second state data update message within the pending message queue not possessing a corresponding acknowledgement message;

requesting retransmission of the acknowledgement messages by the interface component to identify acknowledgement messages lost as a result of the failover event; and

identifying the standby process based on one or more of the second state data update messages that remain unassociated with corresponding acknowledgement messages after the requested retransmission.

18. The method according to claim 9, wherein the first state data update message, the second state data update message, and the acknowledgement message comprise a cookie data field permitting the standby process to encode additional data used to minimize the current state information required to re-synchronize state information with the client process.

19. The method according to claim 14, wherein older messages stored within the pending message queue are processed differently than newer messages stored within the pending message queue following the occurrence of the failover event to dynamically re-synchronize state information.

20. The method according to claim 9, wherein the primary control unit, standby control unit, and interface component collectively perform the functions of a network data router.

21. The method according to claim 9, wherein the standby control unit maintains the state information maintained within the standby process following selected replay of state information.

22. A system comprising:
 - a primary control unit that manages state information;
 - a standby control unit for assuming responsibility for managing the state information upon the occurrence of a failover event; and
 - an interface component;
 - wherein the primary control unit communicates changes to state information to both the standby control unit and the interface component using a state data update message; and
 - the interface component transmits an acknowledgement message to the standby control unit following the successful processing of the state data update message.
23. The system according to claim 22, wherein the interface component communicates the acknowledgement message to the standby control unit via the primary control unit.
24. The system according to claim 22, wherein the interface component communicates the acknowledgement message from the interface component directly to the standby control unit.
25. The system according to claim 22, wherein the state data update message includes a unique operation ID to permit the standby control unit to match the state data update message with a corresponding acknowledgement message.
26. The system according to claim 22, wherein the standby control unit updates state information in the standby control unit using the state data update message following the receipt of a corresponding acknowledgement message.
27. The system according to claim 22, wherein the standby control unit stores the state data update message and the acknowledgement message within a pending message queue.
28. The system according to claim 22, wherein the standby control unit assumes responsibility for maintenance of current state information following the failover event.

29. The system according to claim 28, wherein the standby control unit identifies current state information within the standby process not synchronized with state information in the interface component following the failover event using the state data update message and the acknowledgement message.

30. The system according to claim 23, wherein the standby control unit further identifies state information within the standby process containing out-of-sync state information by requesting retransmission of the acknowledgment message in order to identify any missing acknowledgement messages lost when the failover event occurred.

31. The system according to claim 30, wherein the standby control unit selectively replaying state information to interface component for the standby process containing out-of-sync state information.

32. The system according to claim 25, wherein the state data update message further contain a cookie data field permitting the standby process to encode additional data used to minimize the state information required to resynchronize the standby control unit and the interface component.

33. A system comprising:

means for communicating a first state data update message from a primary control unit to an interface component and a second state data update message to a standby control unit, the first and second state data update messages having a unique operation ID;

means for communicating an acknowledgement message from the interface component to the standby control unit to indicate the successful processing of the first state data update message, the acknowledgement message having the unique operation ID;

means for processing the second state data update message upon receipt of both the second state data update message and the acknowledgement message having identical unique operation ID; and

means for selectively replaying state information to the interface component when the second state data update message was received without a corresponding acknowledgement message upon an occurrence of a failover event;

wherein the standby control unit stores the second state data update message and the acknowledgement message in a pending message queue.

34. The system according to claim 33, wherein the means for selectively replaying state information data comprises:

means for identifying the standby process within the standby control unit containing current state information not synchronized with state information in the interface component using the state data update message stored within the pending message queue;

means for informing the standby process of the out-of-sync condition; and

means for transmitting current state information data from by the standby process to a corresponding client process within the interface component to re-synchronize the state information in the interface component.

35. The system according to claim 34, wherein the means for identifying the standby process within the standby control unit containing current state information not synchronized with state information in the interface component comprises:

means for identifying any second state data update messages within the pending message queue not possessing a corresponding acknowledgement message;

means for requesting retransmission of the acknowledgement messages by the interface component to identify acknowledgement messages lost as a result of the failover event; and

means for identifying the standby process based on one or more of the set of second state data update messages that remain unassociated with corresponding acknowledgement messages after the requested retransmission.

36. The system according to claim 35, wherein the first state data update message, the second state data update message, and the acknowledgement message comprise a cookie data field permitting control unit standby process to encode additional data used to reduce the state information required to re-synchronize state information in the standby control unit with state information in the interface component.

37. A computer-readable medium comprising encoded instructions for causing a standby control unit to:

receive an acknowledgement message received from an interface component forwarded by a primary control unit to the standby control unit to indicate the successful processing of a first state data update message received by the interface component from the primary control unit, the first state data update message and the acknowledgement message having the common unique operation ID;

receive a second state data update message to the standby control unit, the second state data update message having a unique operation ID;

process the second state data update message within the standby control unit to update current state information upon receipt of both the second state data update message and the acknowledgement message; and

selectively replay the current state information data to the interface component when the second state data update message was received without a corresponding acknowledgement message upon an occurrence of a failover event.

38. The computer readable medium according to claim 37, wherein the second state data update message and the acknowledgement message are stored in a pending message queue.

39. The computer-readable medium according to claim 37, wherein the computer-readable medium comprising additional encoded instructions for causing a standby control unit to:

identify a standby process containing current state information not synchronized with state information in the interface component using the second state data update message and the corresponding acknowledgement message stored within a pending message queue; and

transmit the current state information maintained by the standby process to a corresponding client process within the interface component to re-synchronized the state information.

40. The computer-readable medium according to claim 39, wherein the second state data update message and the acknowledgement message are transmitted using a unique virtual communication channel between the standby process and the corresponding client process.

41. The computer-readable medium according to claim 39, wherein the computer-readable medium comprising additional encoded instructions for causing a standby control unit to:

identify the second state data update message within the pending message queue not possessing a corresponding acknowledgement message;

request retransmission of the acknowledgement message to identify any missing acknowledgement messages lost as a result of the failover event; and

identify unacknowledged second state data update messages as corresponding to the client process containing out-of-sync state information.

42. The computer-readable medium according to claim 39, wherein the first state data update message, the second state data update message, and the acknowledgement message comprise a cookie data field permitting the primary control unit to encode additional data used to reduce the current state information required to re-synchronize state information between the standby control unit and the interface component following the failover event.

43. The computer-readable medium according to claim 39, wherein the plurality of standby control unit and the interface component collectively perform functions of a network data router when the standby control unit assumes responsibility for maintaining the current state information following the selected replay of state information.